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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte RONG ZHOU, MINH BINH DO,
TIM C. SCHMIDT, and SERDAR UCKUN

Appeal 2017-007742
Application 13/273,714
Technology Center 2100

Before MAHSHID D. SAADAT, JOHN P. PINKERTON, and JAMES W. DEJMEK, *Administrative Patent Judges*.

PINKERTON, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants[1] appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1–17, which constitute all of the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

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[1] Appellants identify Palo Alto Research Center Inc. as the real party in interest. App. Br. 1.

STATEMENT OF THE CASE

Introduction

Appellants' disclosed and claimed invention is generally directed to "graph searching in the planning area, and more particularly planning in non-deterministic environments, which arise in many real-world applications, including business process management (BPM)." Spec. ¶ 1.[2]

Claim 1 is representative and reproduced below:

> 1. A parallel AND/OR graph search method to search an AND/OR graph performed in an electronic computing environment, the method comprising:
>
> constructing from an AND/OR graph in an original state space, an abstract representation of the AND/OR graph in an abstract state space, by use of state-space abstraction, which includes a many-to-one mapping process;
>
> partitioning duplicate detection scopes by edge partitioning including consideration of alternative outcomes;
>
> expanding nodes in a current search layer using outcome adjusted operator groups;
>
> chaining together multiple successor OR nodes to a same AND node;
>
> updating f-costs, wherein the updating of f-costs includes updating f-costs on ancestor nodes to reflect f-costs of

[2] Our Decision refers to the Final Office Action mailed Feb. 19, 2016 ("Final Act."); Appellants' Appeal Brief filed Nov. 18, 2016 ("App. Br.") and Reply Brief filed Apr. 27, 2017 ("Reply Br."); the Examiner's Answer mailed Feb. 27, 2017 ("Ans."); and the original Specification filed Oct. 14, 2011 ("Spec.").

successor nodes, and wherein the f-costs include an edge cost or operator cost and a node cost;

progressing to a next search layer once all the outcome adjusted operator groups of a present search layer are used; and

repeating at least some of the foregoing steps until a termination condition is reached,

wherein the method is performed using at least one electronic processing device.

App. Br. 21 (Claims App'x).

Rejections on Appeal

Claims 1–17 stand rejected under 35 U.S.C. § 101 because the claimed invention is directed to a judicial exception (i.e., an abstract idea) without significantly more.[3]

Claims 1–3, 16, and 17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhou (US 7,805,454 B2; issued Sept. 28, 2010), Hathaway (US 5,535,145; issued July 9, 1996), and Zien (US 6,556,984 B1; issued Apr. 29, 2003).

Claims 4–15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhou and Hathaway.

ANALYSIS

We have reviewed the Examiner's rejections in light of Appellants' arguments in the Briefs. For the reasons discussed *infra*, we are not persuaded by Appellants' arguments that the Examiner erred in rejecting

[3] This is a new ground of rejection made for the first time by the Examiner in the Answer. *See* Ans. 2–4.

claims 1–17 under 35 U.S.C. § 101. We are, however, persuaded the Examiner erred in rejecting claims 1–17 under 35 U.S.C. § 103(a).

Rejection of Claims 1–17 under § 101

Applicable Law

Under 35 U.S.C. § 101, an invention is patent-eligible if it claims a "new and useful process, machine, manufacture, or composition of matter." 35 U.S.C. § 101. The Supreme Court, however, has long interpreted § 101 to include an implicit exception: "[l]aws of nature, natural phenomena, and abstract ideas" are not patentable. *See, e.g.*, *Alice Corp. Pty Ltd. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014) (internal quotation marks and citation omitted).

The Supreme Court, in *Alice*, reiterated the two-step framework previously set forth in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, 566 U.S. 66, 75–77 (2012), "for distinguishing patents that claim laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts." *Alice*, 134 S. Ct. at 2355. The first step in the analysis is to "determine whether the claims at issue are directed to one of those patent-ineligible concepts." *Id.* For example, abstract ideas include, but are not limited to, fundamental economic practices, methods of organizing human activities, an idea of itself, and mathematical formulas or relationships. *Id.* at 2355–57. If, at the first stage of the *Alice* analysis, we conclude that the claim is not directed to a patent-ineligible concept, it is considered patent eligible under § 101 and the inquiry ends. *Rapid Litig. Mgmt. Ltd. v. CellzDirect, Inc.*, 827 F.3d 1042, 1047 (Fed. Cir. 2016).

If the claims are directed to a patent-ineligible concept, the second step in the analysis is to consider the elements of the claims "individually and 'as an ordered combination'" to determine whether there are additional elements that "'transform the nature of the claim' into a patent-eligible application." *Alice*, 134 S. Ct. at 2355 (quoting *Mayo*, 566 U.S. at 79, 78). In other words, the second step is to "search for an "'inventive concept'"—*i.e.*, an element or combination of elements that is 'sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself.'" *Id.* (brackets in original) (quoting *Mayo*, 566 U.S. at 72–73). The prohibition against patenting an abstract idea "'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment' or adding 'insignificant postsolution activity.'" *Bilski v. Kappos*, 561 U.S. 593, 610–11 (2010) (internal citation omitted).

In determining whether a process claim recites an abstract idea, we must examine the claim as a whole, keeping in mind that an invention is not ineligible just because it relies upon a law of nature or mathematical algorithm. *Digitech Image Tech. LLC v. Electronics for Imaging Inc.*, 758 F.3d 1344, 1350 (Fed. Cir. 2014). As noted by the Supreme Court, "an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection." *Diamond v. Diehr*, 450 U.S. 175, 187 (1981). The "directed to" inquiry asks not whether "the claims *involve* a patent-ineligible concept," but instead whether, "considered in light of the specification, . . . 'their character as a whole is directed to excluded subject matter.'" *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1335 (Fed. Cir. 2016) (internal citations omitted). In that regard, we determine whether the claims "focus on a specific means or method that

improves the relevant technology" or are "directed to a result or effect that itself is the abstract idea and merely invoke generic processes and machinery." *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299, 1314 (Fed. Cir. 2016).

Appellants' Arguments[4]

Appellants contend the decisions in *Flook*[5] and *Benson*,[6] which are cited by the Examiner, are not applicable here because the inventions in those cases do not improve "the operation of an electronic processing device of the electronic computing environment, as in the present case." Reply Br. 2. According to Appellants, "the present claims are more particularly related to concepts such as in connection with the *Enfish* case" in which the claims were found to be directed to improvements in computer-related technology based on the teachings of the specification and, therefore, non-abstract. *Id.* In that regard, Appellants argue the time to perform searching "is a negative aspect of existing systems" and, therefore, "the present disclosure describes concepts for parallelizing AND/OR graph searching, called herein PEP-AO* (i.e., Parallel Edge Partitioning with AO* algorithms)." *Id.* at 3 (citing Spec. ¶¶ 2, 7, 12, 14). Appellants note that paragraph 68 of the Specification discloses that "PEP-AO* has unique memory access patterns" and paragraph 69 further describes "improvements in the operation of the computing environment." *Id.* Appellants also argue

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[4] Appellants argue these claims as a group. *See* Reply Br. 2–5. We consider claim 1 to be representative of the claimed subject matter on appeal and, therefore, we decide the rejection of claims 1–17 on the basis of representative claim 1. *See* 37 C.F.R. § 41.37(c)(1)(iv)(2016).
[5] *Parker v. Flook*, 437 U.S. 584 (1978).
[6] *Gottschalk v. Benson*, 409 U.S. 63 (1972).

that discussions related to improvement in the electronic computing environment are provided in connection with Figure 11 when compared to Figure 10, as shown by the chart of Figure 12. *Id.* at 3–4. Appellants further argue the Examiner's mere reference to Norman Biggs, *Algebraic Graph Theory*, Cambridge University Press (2nd ed. 1993),[7] in finding that the "AND/OR graph is a mathematical construct (or object) and is not limited to a data structure," without supplying the reference and identifying the relevant portions "is insufficient to be accepted as evidence and should be disregarded." *Id.* at 4. In addition, Appellants argue "the claims of the application are directed to specific operations of a particular manner to address AND/OR graph searching," and the claims "do not pre-empt others from undertaking operations in this area." *Id.*

Step One of Alice

The Examiner finds the claims are directed to "a mathematical algorithm based on a mathematical construct (the AND/OR graph)." Ans. 2–3. Specifically, the Examiner finds the claims recite limitations, with varying degree of detail, directed to "the construction and search of an abstracted AND/OR graph," including steps of constructing, partitioning, expanding, chaining, updating f-costs, progressing, repeating, assigning, and searching. *Id.* The Examiner finds "[t]hese steps describe an iterative logical process of traversing and manipulating a mathematical construct." *Id.* at 2. The Examiner further finds as follows:

> The AND/OR graph is a mathematical construct (or object) and is not limited to a data structure. (See, for example, Norman Biggs "Algebraic Graph Theory (2nd ed.)", Cambridge University Press, 1993). The present specification discloses that

[7] This reference is hereinafter referred to as "Biggs."

> the "duplicate-detection scope of an abstract edge is defined as the set of nodes that map to the destination of the abstract edge" ([0030]), i.e., it is a mathematical object. The concept of using a mathematical construct corresponds to concepts identified as abstract ideas by the courts, such as a formula for computing an alarm limit in Flook, and an algorithm for converting binary coded decimal to pure binary in Benson. The concept described in claims 1, 4, 13 and 15 is not meaningfully different than those found by the courts to be abstract ideas. As such, the description in claims 1, 4, 13 and 15 of using a mathematical construct is an abstract idea.

Id. at 2–3.

Considering the focus of claim 1 as a whole, in view of the Specification, we agree with the Examiner that claim 1 is directed to an abstract idea—solving a problem[8] using a mathematical algorithm based on a mathematical construct or object, an AND/OR graph. Consistent with the Examiner's findings (*see* Ans. 2), we find claim 1 is directed to the construction and search of an abstracted AND/OR graph, including the steps of (1) "constructing from an AND/OR graph in an original state space, an abstract representation of the AND/OR graph," (2) "partitioning duplicate detection scopes by edge partitioning," (3) "expanding nodes in a current search layer using outcome adjusted operator groups," (4) "chaining together multiple successor OR nodes to a same AND node," (5) "updating f-costs, wherein the updating of f-costs includes updating f-costs on ancestor nodes to reflect f-costs of successor nodes," (6) "progressing to a next search layer once all the outcome adjusted operator groups of a present search layer are

[8] The Specification states that "[g]raphs are used to represent problems and are employed to find solutions to problems, wherein finding a path through a graph represents a solution to a represented problem." Spec. ¶ 4.

used," (7) "repeating at least some of the foregoing steps until a termination condition is reached," and (8) "the method is performed using at least one electronic processing device." App. Br. 21 (Claims App'x). Also consistent with the Examiner's findings (*see* Ans. 2), we find claim 1 "is an iterative logical process of traversing and manipulating a mathematical construct" or object, an AND/OR graph. We also note that in regard to "updating f-costs . . . to reflect f-costs of successor nodes," as recited in claim 1, mathematical calculations are performed, as described in paragraphs 52–56 of the Specification with reference to Figures 5A-5D, and as described in paragraph 8 of the Specification, as follows:

> To update the f-cost of a state s, set f(s) = mins'[c(s, s')+f(s')] where s' is a successor state of s and c(s, s') is the cost of going from state s to state s'. The action that takes s to its best successor, $\text{argmin}_{s'}$ [c(s, s')+f(s')], is marked as the best action for states (where argmin_s stands for the arguments of the minimum).

Thus, we see no meaningful difference in claim 1 and similar claims in other cases that our reviewing court has found are directed to an abstract idea. For example, our reviewing court has concluded, absent additional limitations, "a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible." *Digitech*, 758 F.3d at 1351. Further, "analyzing information by steps people go through in their minds, or by mathematical algorithms, without more, [are] essentially mental processes within the abstract-idea category." *Electric Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016); *see also Synopsys, Inc. v. Mentor Graphics Corp.*, 839 F.3d 1138, 1146 (Fed. Cir. 2016). "[T]he fact that the required calculations could be performed more efficiently via a computer does not materially alter the

patent eligibility of the claimed subject matter." *Bancorp Servs., LLC v. Sun Life Assurance Co. of Can. (U.S.)*, 687 F.3d 1266, 1278 (Fed. Cir. 2012).

Further, merely combining several abstract ideas does not render the combination any less abstract. *RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017) ("Adding one abstract idea . . . to another abstract idea . . . does not render the claim non-abstract."); *see also FairWarning IP, LLC v. Iatric Sys., Inc.*, 839 F.3d 1089, 1094 (Fed. Cir. 2016) (determining the pending claims were directed to a combination of abstract ideas).

Appellants' arguments that the "present claims match the reasoning of *Enfish* in improving the operation of an electronic computing environment" are unpersuasive. Reply Br. 2–4. First, the claims at issue in *Enfish* focused not on asserted advances in uses to which existing computer capabilities could be put, but on a specific type of data structure, i.e., a self-referential table for a computer database, designed to improve the way a computer carries out its basic functions of storing and retrieving data. *Enfish*, 822 F.3d at 1335–36. We find no parallel between claim 1 and the claims in *Enfish*, nor any comparable aspect in claim 1 that represents "an improvement to computer functionality." Second, Appellants' arguments that (1) the Specification describes improved operational time for searching based on parallelizing AND/OR graph searching (Reply Br. 3, citing Spec. ¶¶ 7, 12, 14), (2) "PEP-AO* has unique memory access patterns" (*id.*, citing Spec. ¶ 68), and (3) paragraph 69 of the Specification further describes "improvements in the operation of the computing environment" (*id.*) are unpersuasive because they are not commensurate with the scope of claim 1. That is, to the extent any "improvement" is described in Appellants'

Specification, no such improvement to computer memories or functionality is recited in claim 1. *See Accenture Global Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1345 (Fed. Cir. 2013) (admonishing that "the important inquiry for a § 101 analysis is to look to the claim"; "the complexity of the implementing software or the level of detail in the specification does not transform a claim reciting only an abstract concept into a patent-eligible system or method"). In that regard, our reviewing court's holding in *In re Warmerdam*, 33 F.3d 1354, 1360 (Fed. Cir. 1994), is also instructive:

> Warmerdam's other argument, that the manipulation of data as described in the claims constitutes or represents a sufficient level of physical activity to impart patentability to the claim, is not convincing. It is true, particularly with ideas expressed in mathematical form, that if a claim requires more than the manipulation of ideas so that the process described in the claim produces something quite different, then the process might indeed describe statutory subject matter. The problem with Warmerdam's argument is that the claims here do not have that effect. It is the claims which define the metes and bounds of the invention entitled to the protection of the patent system. *Zenith Lab. Inc. v. Bristol–Myers Squibb Co.*, 19 F.3d 1418, 1424, 30 USPQ2d 1285, 1290 (Fed.Cir.1994). Thus, the argument is unavailing. We conclude the Board did not err in sustaining the rejection of claims 1–4 under § 101.

We also are not persuaded by Appellants' arguments regarding the Examiners finding that the "AND/OR graph is a mathematical construct (or object) and is not limited to a data structure." Reply Br. 4. Although we agree with Appellants that Biggs should be disregarded because the Examiner did not identify the relevant portions of the reference, Appellants have not provided persuasive evidence or argument that the AND/OR graph

or abstracted AND/OR graph of claim 1 is a "data structure." Appellants state that an internet search of the words "graph data structure" identifies "a multitude of concepts that identify a graph as being a type of data structure." *Id.* Appellants have not, however, cited or identified any of such "multitude of concepts." Nor have Appellants identified any portion of the Specification describing the claimed "AND/OR graph" or "abstract representation of the AND/OR graph" as a "data structure," and we also have not identified any such portion of the Specification. Further, Appellants have not provided persuasive evidence or reasoning that claim 1, viewed in light of the Specification, describes a specific type of data structure designed to improve the way the computer processing device carries out its basic functions of constructing an abstract AND/OR graph and traversing, manipulating, and analyzing the graph, including updating f-costs. Appellants' argument that the Examiner's position "is in opposition to the USPTO's guidance against arguing too high a level of abstraction" (*see* Reply Br. 4) is also not persuasive because the Examiner considered all of the limitations of claim 1 in finding it is directed to the abstract idea of "a mathematical algorithm based on a mathematical construct (the AND/OR graph)."

Step Two of Alice

Regarding step two of the *Alice* analysis, the Examiner finds the claims do not included additional elements that amount to significantly more than the abstract idea. Ans. 3. Although the Examiner finds claims 1, 4, 13, and 15 recite an "electronic processing device" for performing the steps, and claim 13 additionally recites a "memory," the Examiner also finds these components "are recited at a high level of generality and are recited as

performing generic computer functions routinely used in computer applications." *Id.* The Examiner further finds "[t]here is no indication that the combination of elements improves the functioning of a computer or improves any other technology." *Id.* We agree with these findings and, for the reasons discussed above, are not persuaded by Appellants' arguments that the claims "match the reasoning of *Enfish* in improving the operation of an electronic computing environment." *See* Reply Br. 2–4.

Claim 1 does not "focus on a specific means or method that improves the relevant technology," but is "directed to a result or effect that itself is the abstract idea and merely invoke[s] generic processes and machinery." *McRO*, 837 F.3d at 1314. Instead, claim 1 essentially recites a generic electronic processing device that performs functions specified at high levels of generality. This is not enough to transform an abstract idea into patent-eligible subject matter. *See, e.g.*, *Alice*, 134 S. Ct. at 2360 (explaining that claims that "amount to 'nothing significantly more' than an instruction to apply the abstract idea . . . using some unspecified, generic computer" "is not '*enough*' to transform an abstract idea into a patent-eligible invention" (quoting *Mayo*, 566 U.S. at 77, 79)); *Intellectual Ventures I LLC v. Capital One Fin. Corp.*, 850 F.3d 1332, 1342 (Fed. Cir. 2017) ("[T]he claim language here provides only a result-oriented solution, with insufficient detail for how a computer accomplishes it. Our law demands more."). Thus, we see nothing in the limitations of claim 1, considered "both individually and as an ordered combination," that transforms the claimed abstract idea into patent-eligible subject matter.

Preemption

We also are not persuaded by Appellants' arguments that the claims are directed to specific operations for AND/OR graph searching and "do not pre-empt others from undertaking operations in this area." Reply Br. 4. "While preemption may signal patent ineligible subject matter, the absence of complete preemption does not demonstrate patent eligibility. . . . Where a patent's claims are deemed only to disclose patent ineligible subject matter under the *Mayo* framework, as they are in this case, preemption concerns are fully addressed and made moot." *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1379 (Fed. Cir. 2015); *see also OIP Techs. Inc. v. Amazon.com, Inc.*, 788 F.3d 1359, 1362–63 (Fed. Cir. 2015) ("that the claims do not preempt all price optimization or may be limited to price optimization in the e-commerce setting do not make them any less abstract").

Accordingly, for the reasons discussed above, we sustain the Examiner's rejection of claim 1 under § 101. For the same reasons, we sustain the rejection of independent claims 4, 13, and 15, and dependent claims 2, 3, 5–12, 14, 16, and 17, which are not separately argued, under § 101.

Rejection of Claims 1–17 under § 103(a)

In rejecting claims 1, 4, 13, and 15, the Examiner finds "Hathaway teaches [an] AND/OR graph, and constructing from an AND/OR graph in an original state space, an abstract representation of the AND/OR graph." Final Act. 4, 8, 13, 16. Regarding claim 1, Appellants argue "Hathaway does not teach or fairly suggest the use of an AND/OR graph and therefore cannot/does not undertake the further alleged operations related thereto."

App. Br. 8. Appellants assert this argument is also relevant and applicable to claims 4, 13, and 15. *Id.* at 16, 18, 19.

In particular, Appellants argue Hathaway does not teach an AND/OR graph because, as shown in Figures 5 and 6 of Hathaway, there is no "arc" element, and the AND node in all conventions of AND/OR graphs "must have its successors connected with the 'arc.'" App. Br. 8–9. Appellants also argue an AND/OR graph is not even applicable to Hathaway because the problem is not about achieving a goal modeled as a node in the graph, as in the present application, but Hathaway is about trying to reduce the total number of edges in the delay abstraction and the solution "is about which edge should be merged with another edge or removed from the graph." *Id.* at 10. According to Appellants, "[t]he delay graph of Hathaway only models the delay aspects of the circuit, which is a reason why Hathaway's graph has nothing to do with the actual logical operations performed by the gates, be it AND, OR, or Negation." *Id.* Appellants further argue:

> Hathaway's discussion of AND gates and OR gates is very different from the claimed AND/OR graph of the present application. The graph Hathaway is searching is still an ordinary OR graph, which consists of vertices that correspond to AND gates or OR gates. Appellants respectfully believe this distinction has become confused based on an understanding of the AND/OR graphs. Simply because the vertices of a graph represented both AND gates and OR gates, does not make it an AND/OR graph.

Id. at 13; *see also* Reply Br. 6.

The Examiner finds the "arc" denotes the existence of successors of AND nodes in a graphical manner, "but bears no significance in the actual algorithm which constructs and searches the abstracted AND/OR graph, as

claimed." Ans. 4. The Examiner interprets the claimed "AND/OR graph as a graph with AND and OR gates/nodes." *Id.* at 5. The Examiner further finds "whether the presently claimed invention is applied to an AND/OR graph or another type of graph does not alter its functionality." *Id.*

We are persuaded by Appellants' arguments that the Examiner erred. First, we conclude the Examiner's interpretation of the term "AND/OR graph" is overly broad, and inconsistent with Appellants' Specification, because it includes any graph of a circuit with AND and OR gates, regardless of whether the existence of successors of AND nodes are shown in a graphical manner. Second, we agree with Appellants that the graph Hathaway is searching is an ordinary OR graph and merely because the vertices are represented by AND gates and OR gates does not make it an AND/OR graph. App. Br. 13; Reply Br. 6.

Thus, on this record, the preponderance of the evidence does not support the Examiner's finding that Hathaway teaches or suggests the claimed "AND/OR graph" and "constructing from an AND/OR graph in an original state space, an abstract representation of the AND/OR graph," as recited in claim 1, and as similarly recited in claims 4, 13, and 15. Accordingly, we do not sustain the Examiner's rejection of independent claims 1, 4, 13, and 15, as well as dependent claims 2, 3, 5–12, 14, 16, and 17 under § 103(a). *See In re Caveney*, 761 F.2d 671, 674 (Fed. Cir. 1985) (Examiner's burden of proving non-patentability is by a preponderance of the evidence).

DECISION

We affirm the Examiner's decision rejecting claims 1–17 under

35 U.S.C. § 101.

We reverse the Examiner's decision rejecting claims 1–17 under 35 U.S.C. § 103(a).

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1). *See* 37 C.F.R. § 1.136(a)(1)(iv)(2016).

AFFIRMED